

# **Spray Polyurethane Foam (SPF) for Residential Construction and Code Compliance**

State of Connecticut Career Development - October 2011



# Welcome

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# Learning Objectives

- After completing today's course, you will be able to:
- Explain the different types of spray polyurethane foams (SPF) used in residential construction. Identify the different physical / performance properties of open- and closed-cell SPF materials.
- Describe the requirements of foam plastics within the building codes and show how these products meet compliance, for construction and safety practices.
- Identify the various areas of the residential building envelope where SPF is best used and discuss the preferred type of SPF for each area.
- Distinguish the features and benefits of using spray polyurethane foam for residential construction, including sustainable attributes and compliance with more stringent energy efficiency requirements.



# What You Need To Know about SPF

## ■ Open-Cell Spray Foam

- “1½-lb” density
  - Semi-rigid spray foam
  - Low density
- Fills up the wall cavity
  - High expansion
  - Shaving required
- Water blowing agent
  - Expands & leaves open air pockets
- R-value = 3.4-3.9/inch
- No structural value

## ■ Closed-cell Spray Foam

- “2-lb.” density
  - Rigid SPF
  - High/medium density
- Not full wall thickness
  - Controlled expansion
  - Hybrid system applications
- Non-ozone depleting (HFC) blowing agent
  - Millions of tiny closed-cells trap this high-efficiency gas
- R-value = 6.0-7.0 per inch
- Offers up to 300% increased structural value (over 2”)



# What You Need To Know about SPF

## ■ Open-Cell Foam

- Air Barrier at 3.5"
  - Meets sealant requirement of IECC
- Vapor retarder typically required in cold climates
  - 5" application = 10 perms
- Water can absorb (up to 40% by volume)
  - Do not use below grade or on ductwork
- Offers sound absorption and barrier performance

## ■ Closed-cell Foam

- Air Barrier at 1"
  - Meets sealant requirement of IECC
- Code defined vapor retarder at 2" or greater
  - 2" application = 0.95 perms
- Difficult for water to absorb (less than 4% water absorption) - Hydrophobic
  - FEMA Flood Resistant
- Offers sound barrier performance only (will not absorb noise)



# SPF and the International Codes

- Code Sections relevant to SPF in the “I-codes”
  - Separate from ‘traditional’ insulations, but prescriptive requirements for foam plastics are included in each
  - IBC: Ch 26, Section 2603 Foam Plastic Insulation
  - IRC: Ch 3 - R314 Foamed Plastic, R320 Protection Against Subterranean Termites
- Code Focus
  - Fire Protection
  - Thermal Performance
  - Moisture Control
  - Termite Control

# Surface Burning Requirements

## ■ Surface Burning Characteristics [IBC 2603.3 / IRC R314.3]

- ASTM E84 / UL 723 Steiner Tunnel Test
  - Flame Spread Index (FSI)
  - Smoke Developed Index (SDI)
    - FSI/SDI is 0/0 for fiber-cement
    - FSI/SDI is 100/100 for red oak
  - **Limited to 4" specimen thickness**
- Class II – FSI  $\leq 75$ , SDI  $\leq 450$
- Class I – FSI  $\leq 25$ , SDI  $\leq 450$
- Roofing – FSI  $\leq 75$ , SDI unlimited
- Due to thickness limitation of ASTM E84, all SPF manufacturers should have additional testing >4" to allow for greater application thickness
  - NFPA 286 with an interior finish surface (of a 15-minute thermal barrier)







# Thermal Barrier Requirements

- Thermal Barrier Protection [IBC 2603.4 / IRC R314.4]
  - Separates SPF insulation from interior of building for fire protection
  - Approved 15 minute thermal barriers:
    - ½" gypsum wallboard is most commonly used
    - Others to be tested per ASTM E119 and/or full-scale fire tests
  - Exceptions to Thermal Barrier requirements...



# Thermal Barrier Exceptions

- Inside masonry or concrete walls\*  
[IBC 2603.4.1.1 / IRC R314.5.2]
- Cooler and freezer walls\* [IBC 2603.4.1.2-3]
- Laminated metal wall panels-one story [IBC 2603.4.1.4]
- Roofing assembly\* [IBC 2603.4.1.5 / IRC R314.5.2]

\* Where SPF applications are relevant here

# Thermal Barrier Exceptions

## ■ Sill Plates and Headers [IBC 2603.4.1.13 / IRC R314.5.11]

- Not required to install thermal barriers in the rim joist area
- Limited to Type V construction, with three requirements:
  - Class I Foam
  - Max thickness 3.25"
  - Medium (2#) density foam only
    - 09 IRC will allow 1/2#



# Thermal Barrier Exceptions

## ■ Attics and Crawl Spaces

[IBC 2603.4.1.6 / IRC R314.2.3]

- Where entry is made for service of utilities only...(no storage)
- As an alternative to the thermal barrier (lesser requirement) an Ignition barrier is required separating attic/crawlspace space from foam
  - In unvented attics or where SPF is sprayed on flat ceiling
- Thermal barrier required between attic/crawlspace and occupied space





# Ignition Barrier Requirements

## ■ Ignition Barrier [IBC 2603.4.1.6 / IRC R314.2.3]

### □ Prescriptive ignition barriers include:

- 1.5" mineral fiber insulation
- 0.25" wood structural panels
- 0.375 particleboard
- 0.25" hardboard
- 0.375" gypsum board
- Corrosion-resistant steel having a base metal thickness of 0.016 "

### □ Alternative Assemblies by Special Approval Testing – End-Use Fire Tests listed in Specific Approval Section R314.6

- Accepted by the local code official or included in an ICC  
Evaluation Services Report (ICC-ESR)

# End-Use Fire Testing

- Special Approval for Foam In Attics and Crawlspaces
  - ICC-ES has issued ESR's in the past for this application
    - Qualifies foam alone or foam with intumescent coating
    - SPFA-committee worked with ICC-ES to update alternative testing procedure – CHANGE WAS EFFECTIVE JUNE 2009





# Combustibility of SPF

- ❑ SPF is an organic material – it will burn! Code requires thermal and ignition barriers to reduce the risk of ignition and flash fire.
- ❑ Other types of thermal barriers are available in addition to gypsum board:
  - ❑ spray-applied cementitious and cellulose materials
  - ❑ portland cement plaster and other proprietary materials
- ❑ Thermal barrier materials should have an ICC-ES Report with report number and validity dates
- ❑ Code officials accept thermal barriers that have not been evaluated by ICC-ES on the basis of performance in those generally accepted full-scale, end-use tests.



# History of Industry Testing Changes

- SPFA committee was formed in 2009 based on a request of the International Code Council to raise the bar for testing standards for SPF applications
  - As of June 2009, the industry agreed that previous kraft-faced insulation baseline comparison tests were no longer acceptable for attic and crawlspace evaluation for SPF
    - **These tests had once allowed many companies, with open-cell products, to pass without fire protection in limited access attics & crawlspaces**
  - Effective Dec. 31<sup>st</sup>, 2009, the ICC removed all sections containing the kraft-faced comparison testing & approvals from existing ICC reports
- Since June 1<sup>st</sup>, 2010 and on, only tests based upon Appendix X of AC377 Acceptance Criteria will be accepted for alternative applications to the code-prescribed ignition barriers
  - Limitations of use still exist in accordance with “limited access” restrictions within the ICC, for attics and crawlspaces only
    - Entry to the attic or crawlspace is only to service utilities, and no storage is permitted
    - There are no interconnected attic areas, or crawl space areas
    - Air in the attic or crawl space is not circulated to other parts of the building
  - **If any of the above conditions exist, a thermal barrier (gypsum or equivalent) must be used over ALL products, regardless of testing**





# Revisions to ICC Evaluation Reports

- ICC Reports with interim comparison tests (Appendix A) were allowed until Dec. 31<sup>st</sup>, 2010
  - Effective February 1<sup>st</sup>, 2011 these tests are no longer applicable, and approvals in current ICC-ESR's have or will be removed
  - What does this mean: Many products that previously were allowed to be left exposed are now required to be covered!
  - Some crawlspace assemblies will pass with alternative tests without coating while they will not in an attic configuration (Appendix C)
- Go to [www.icc-es.org](http://www.icc-es.org) to view updated ICC reports

# Full-Scale Fire Tests

## ■ Special Approval Tests [IBC 2603.9 / IRC R314.6]

- NFPA 286 - Contribution of Wall and Ceiling Interior Finish to Room Fire Growth (with the acceptance criteria of Section 803.2/R315.4)
- FM 4880 - Fire Rating of Insulated Wall or Wall and Roof/Ceiling Panels, Interior Finish Materials or Coatings, and Exterior Wall Systems
- UL 1040 - Safety Fire Test of Insulated Wall Construction
- UL 1715 – Fire test of interior finish material
- ***End-use fire tests***





# Thermal Performance

## ■ Thermal Performance, R-value

[IBC 1301 → IECC 102.1.1 / IRC N1102.1 / 16CFR Part 460 ]

- Measured per ASTM C 518 or C 177
- At installed thickness or extrapolated from R-value at representative thickness per FTC rule; Refer to ICC-ESR or technical data sheet
  - R-value is not linear with thickness
    - AC-377 R-value must be tested at 1 inch and 3.5 inches (or greater, no less), with extrapolation to be allowed for thicker applications based on the maximum tested thickness
- Must be aged R-value for SPF, as applicable

# R-value & Thermal Performance

- Closed-cell SPF has superior R-values compared to conventional insulations
  - Maintains performance in real-world temperatures and conditions
    - R-6-7 per inch (based upon AC377 requirements)
    - Although testing for closed-cell R-value is also not linear, it's to the benefit of a ccSPF due to stability of the closed-cells, which often increases the R-value with thicker samples
- Offers better thermal performance because air is replaced with less conductive blowing agents
- Not subject to convection
- Higher effective performance
  - ORNL Studies
    - Attics
    - Walls





# Moisture Resistance Performance

- Moisture Vapor Permeance [IECC 402.5 / IRC R318]
  - Measured per ASTM E 96 dry cup (method A)
    - Perm units indicate the rate of water vapor transmission through a material at a specified thickness
      - Higher perm ratings indicate more water vapor transmission
- IECC and IRC require a vapor retarder on the 'warm in winter' side of the building envelope in climate zones  $\geq 5$ , and Marine Zone 4
- To qualify as a vapor retarder, the material must have  $\leq 1$  perm
  - Most closed-celled foams have less than  $\leq 1$  perm at thickness  $\geq 2$  inches
  - Open-celled foams are about 4-16 perms at an installed thickness of 4 inches, and require the addition of a vapor retarder to comply with code in climate zones where one is required
- 2009 IRC / IECC recognize materials between 1-10 perms as Class II vapor retarders, which are also acceptable

# Unvented Attics

## ■ Unvented Attics

[IRC R806.4 2006 or newer]

- IRC allows unvented attics in all climate zones
  - Unvented attic within thermal envelope
  - No vapor retarder on attic floor
  - Special ventilation for wood shingles
  - Vapor retarder requirements in cold climates (ASTM E96 a)
  - Air-impermeable insulation requirements (ASTM E283 or E2178)
  - Chart describes the amount of R-value required by the air-impermeable insulation when using a hybrid system with fibrous insulation underneath it





# Ductwork

- 2009 IRC Changes on Duct Insulation –
  - M1601.3 Duct Insulation Materials: Now allows for SPF to be used in direct contact with ductwork, with conditions:
    - Foam plastic must be Class1 (25 or less FS, 450 or less SD ratings)
    - Foam at installed thickness must be less than 3 perms to prevent moisture accumulation (means ccSPF ONLY!)
    - Foam plastic must be covered with ignition barriers per R314.5.3 / 5.4
    - Foam plastic must comply with requirements of R314
  - Eliminates need for additional vapor retarder
  - Eliminates need for additional joint sealing/caulking



# Termite Resistance

## ■ IRC R320.5 Termite Resistance –

- In areas determined to be “Very Heavy” with termite infestation, foam insulations (all types) shall not be used on the exterior of the foundation
  - All foam plastics installed above grade must have a 6” clearance to exposed earth
  - Very Heavy areas include: Most of CA, East half of TX, LA, MS, AL, FL, GA, SC
  - Exceptions for use:
    - Interior applications below grade
    - Where the entire building is built of non-combustible materials or pressure-positive treated wood
    - When an approved method of protecting the foam & structure from damage is used





# SPF and Code Compliance

- Product documentation showing compliance with prescriptive code requirements
  - 3<sup>rd</sup> Party Test Data, Technical Data Sheets, etc.
- ICC-Evaluation Service Reports (ESR)
  - Acceptance Criteria for Spray Polyurethane Foams
    - Required Data
      - R-value, Surface Burning Characteristics (at thickness), Physical Properties
    - Optional Data
      - Air permeance, Water absorption, WVTR, Full-scale fire tests,...
  - Newest versions always available at [www.icc-es.org](http://www.icc-es.org)

# Identifying Open vs. Closed-cell SPF – Quick Tips for Visual Inspection

## ■ Open-cell SPF Physical Attributes

- ❑ Higher expansion
- ❑ Often more high and low spots than CCF (prior to cutting)
- ❑ Softer & spongy – can push into it or put finger through
- ❑ Will typically be full stud thickness
- ❑ Will usually be shaved flush with studs = fairly smooth finished surface
- ❑ Typically white or light yellow in color



## ■ Closed-cell SPF Physical Attributes

- ❑ Lesser expansion
- ❑ More even surface than OCF (prior to cutting)
- ❑ Firm to the touch (will not compress easily)
- ❑ Will typically not fill full stud cavity when thickness meets R-value
- ❑ Typically a variety of colors, including green, purple, dark yellow, light yellow or white





# On the Jobsite

- Product Labeling [IBC 2603.2 / IRC R314.2]
  - ☐ Containers on job site shall have mfg name, product ID, product listing, suitability for use
  - ☐ Alternately,
- Installation Certificate [IECC 102.1.1 / IRC N1101.8] –  
New for SPF in 2009 I-codes (*see examples on next page*)
  - ☐ Provided by contractor to builder/homeowner
  - ☐ Thickness, R-value and product listing or data sheet
  - ☐ Placed on electric service panel or other conspicuous location

# Insulation Cards for Spray Foam Insulations (per IRC N1101.8)

INSULATION CARD - DO NOT REMOVE			
BASF		The Chemical Company	
ICC-ESR - 2642			
This form must be filled out and posted to comply with building code and FTC requirements. Meets IRC Section N1101.4 requirements. Please post near electrical panel.			
<b>PLEASE ATTACH PRODUCT TECHNICAL DATA SHEET BEFORE POSTING</b>			
The following spray polyurethane foam insulation system(s) has been installed. Consult International Building Code, Section 2603 Foam Plastic Insulation, International Residential Code (IRC) R314 Foam Plastics, or International Energy Conservation Code (IECC) Section 102 for specific requirements.			
This spray polyurethane foam insulation system has been installed in accordance with manufacturer's processing guidelines to provide a thermal resistance of _____.			
Area Insulated	R-Value	Thickness*	
Attic Area	R- _____	② inches	
Sloped Ceilings	R- _____	② inches	
Walls (Where: )	R- _____	② inches	
Walls (Where: )	R- _____	② inches	
Floors (over an unheated crawl space)	R- _____	② inches	
Crawl Space Perimeter	R- _____	② inches	
Basement Exterior Walls	R- _____	② inches	
Other (Where: )	R- _____	② inches	
*Nominal thicknesses are representative of a field, spray-applied foam material.			
<b>BASF Polyurethane Foam Enterprises Product(s) Installed:</b> (Please Print Clearly)			
Walls: <input type="checkbox"/> COMFORT FOAM® Permeance: _____ perms at _____" thickness Density: Nominal 2#			
<input type="checkbox"/> SPRAYTITE® Permeance: _____ perms at _____" thickness Density: Nominal 2#			
Flame Spread Rating (ASTM E-84): <input checked="" type="checkbox"/> Class 1 (25 or less) <input type="checkbox"/> Class 2 (75 or less) tested at _____" thickness**			
Other: <input type="checkbox"/> COMFORT FOAM® Permeance: _____ perms at _____" thickness Density: Nominal 2#			
<input type="checkbox"/> SPRAYTITE® Permeance: _____ perms at _____" thickness Density: Nominal 2#			
Flame Spread Rating (ASTM E-84): <input checked="" type="checkbox"/> Class 1 (25 or less) <input type="checkbox"/> Class 2 (75 or less) tested at _____" thickness**			
Basement Exterior: <input type="checkbox"/> COMFORT FOAM® Permeance: _____ perms at _____" thickness Density: Nominal 2#			
<input type="checkbox"/> SPRAYTITE® Permeance: _____ perms at _____" thickness Density: Nominal 2#			
Flame Spread Rating (ASTM E-84): Not Applicable			
(Please Print Clearly)			
Jobsite Location: _____ Date Installed: _____			
Building Contractor: _____			
Insulation Contractor: _____ Phone: _____			
Installed By: _____			
Caution—No Hot Work—Polyurethane foam is combustible and should be treated as such. No welding or cutting unless foam has been protected from accidental ignition by open flame.			
<b>INSULATION CARD - DO NOT REMOVE</b>			

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Area Insulated	R-Value	Thickness*	
Attic Area	R- _____	② inches	
Sloped Ceilings	R- _____	② inches	
Walls (Where: )	R- _____	② inches	
Walls (Where: )	R- _____	② inches	
Floors (over an unheated crawl space)	R- _____	② inches	
Crawl Space Perimeter	R- _____	② inches	
Basement Exterior Walls	R- _____	② inches	
Other (Where: )	R- _____	② inches	
*Nominal thicknesses are representative of a field, spray-applied foam material.			
<b>BASF Polyurethane Foam Enterprises Product(s) Installed:</b> (Please Print Clearly)			
Walls: <input type="checkbox"/> ENERTITE® Permeance: _____ perms at _____" thickness Density: Nominal 0.5#			
Flame Spread Rating (ASTM E-84): <input checked="" type="checkbox"/> Class 1 (25 or less) <input type="checkbox"/> Class 2 (75 or less) tested at _____" thickness**			
Other: <input type="checkbox"/> ENERTITE® Permeance: _____ perms at _____" thickness Density: Nominal 0.5#			
Flame Spread Rating (ASTM E-84): <input checked="" type="checkbox"/> Class 1 (25 or less) <input type="checkbox"/> Class 2 (75 or less) tested at _____" thickness**			
Foundation: <input type="checkbox"/> ENERTITE® Permeance: _____ perms at _____" thickness Density: Nominal 0.5#			
Flame Spread Rating (ASTM E-84): <input checked="" type="checkbox"/> Class 1 (25 or less) <input type="checkbox"/> Class 2 (75 or less) tested at _____" thickness**			
(Please Print Clearly)			
Jobsite Location: _____ Date Installed: _____			
Building Contractor: _____			
Insulation Contractor: _____ Phone: _____			
Installed By: _____			
Caution—No Hot Work—Polyurethane foam is combustible and should be treated as such. No welding or cutting unless foam has been protected from accidental ignition by open flame.			
<b>INSULATION CARD - DO NOT REMOVE</b>			



# Questions on Codes?

- 10 minute break

# Residential Applications



*courtesy BASF*



*courtesy BASF*



*courtesy Honeywell/BSC*



*courtesy Honeywell*



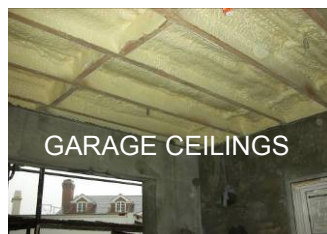
*courtesy SPFA*



*courtesy BASF*



*courtesy Honeywell*



*courtesy Honeywell*



*courtesy BASF*



*courtesy Honeywell*



*courtesy BASF*



# Residential / Light Commercial Applications with Open-cell SPF



- Open-cell 1/2# SPF for residential and commercial structures
  - 2-4x the cost of conventional insulation, but energy savings also allows greater payback than most insulation materials – more than just insulation:
    - High expansion-fills studs
    - Speedy, single pass application
    - Air barrier performance
    - Higher insulation performance (similar R-value to conventional)
    - Moisture & vapor permeable
    - Non-structural
    - Sound absorption & control

# Residential / Light Commercial Applications with Closed-cell SPF



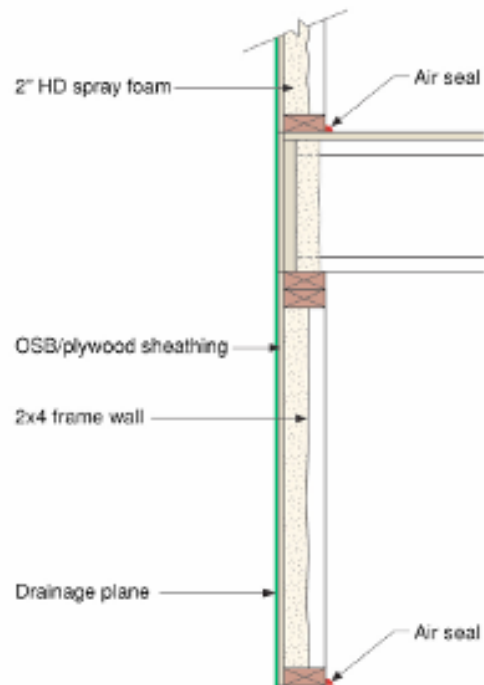
- Closed-cell 2# SPF for residential and commercial structures
  - 3-5x the cost of conventional insulation, but greater energy savings over time than any other insulation system – more than just insulation:
    - Controlled expansion, can be used in combination approach with other insulations
    - Adds strength - Straighter, stronger walls
    - Storm resistance in sealed attics
    - Highest insulation performance - R-value of 6.5-7 per inch
    - Moisture and vapor resistance
    - Superior air barrier material
    - Sound control



# All Closed-cell SPF for walls

**Closed-cell SPF alone is a superior wall insulation when space is at a premium**

- ccSPF can obtain R-19 walls using standard 2x4 framing
- Provides ultimate thermal performance, air sealing and water vapor control
- Belt and Suspenders approach to water intrusion - Reduce Mold Risk
- Offers structural enhancements – stronger, straighter walls




# Open-cell SPF SPF for Walls

## **Open-cell SPF is an excellent wall insulation system**

- With full cavity fill in a 2x6 can obtain R-19 walls
  - Conforms to hard to insulate areas
  - Fills gaps and cracks
- Provides efficient thermal performance and air sealing
- Semi-vapor permeable
  - Most cold climate zones will require an interior vapor retarder





# Special Considerations for Vapor Control with Open-cell Foam

- Code requirements for “warm-in-winter” vapor retarder placement (Zones 5-8 and Marine 4) is still enforced when open-cell foams are used
  - Continuous, properly installed vapor retarder
    - Poly or “Smart” membranes
    - Interior vapor retarder paint / primer
- New code 2009 IRC allows up to 10 perm product (Class III) to meet requirements for vapor control in certain wall assemblies:
  - In zone Marine 4 and zone 5, when using vented cladding over OSB, plywood, gypsum and fiberboard.
  - In zones Marine 4 and higher, when insulated sheathing or 2 pcf SPF is used (as part of a hybrid assemblies with open-cell foam) at given r-values in code tables for each zone

# SPF Seals and Fills In Hard to Insulate Areas



**\*Note separation from can lights –**

**As with all insulation materials, a 3" separation is required from all heated appliances/ penetrations**

**With SPF, even IC-rated lights should have a box or batt to separate foam from direct contact, to all for heat dissipation**



# Special Considerations - Substrates / Primers

- Must be a **clean, dry, sound surface** to spray
  - Suitable to Wood, Concrete, and Metal surfaces
    - Consult BASF for any questionable applications
  - **Surface must be free of grease, wax, oil, loose particles, moisture or other foreign matter**
    - Must be properly prepped OR primed for SPF to adhere
    - Questionable surfaces include:
      - Gluelams, LVL's or Microlams = Wood with a wax coating
      - The “wrong” side of the OSB (outside smooth surface)
      - Certain powder-coatings on metal surfaces
      - self adhered asphaltic membranes (such as W.R. Grace perm a barrier, Henry Blueskin SA, etc.) must be flash coated to maximize adhesion
  - **Primers may be necessary** on many surfaces, such as concrete or metal = cold, smooth or wet surfaces that may affect adhesion
    - Typically acrylic or epoxy based primers – Please consult BASF for recommendation



# Build Tight, Ventilate Right

- To address air infiltration and related moisture concerns, many building scientists have concluded that houses should be as tight and seamless as possible<sup>1</sup>
- The American Lung Association also recommends that homes need to be as tight as practical<sup>2</sup>
- Random natural infiltration should be minimized and controlled mechanical ventilation should be employed<sup>3</sup>

1. Arnie Katz, Director, Affordable Housing, Senior Building Science Consultant  
[www.advancedenergy.org/buildings/about/specialists/arnie\\_katz.html](http://www.advancedenergy.org/buildings/about/specialists/arnie_katz.html)

2. American Lung Association [www.healthhouse.org/build/TopTenQuestionsbooklet.pdf](http://www.healthhouse.org/build/TopTenQuestionsbooklet.pdf)

3. [www.buildingscience.com](http://www.buildingscience.com)





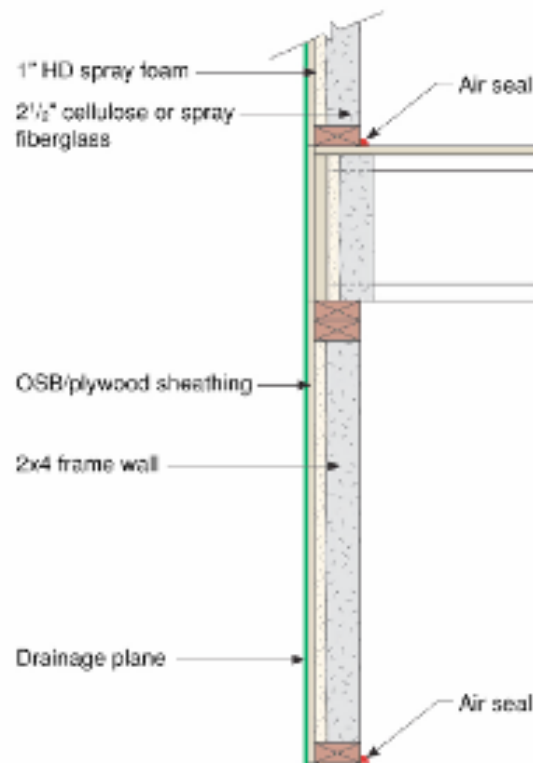
# Trends in Ventilation and Indoor Air Quality Control

- ERV and HRV are becoming more affordable
- As with all air-tight building approaches, homes built with spray foam should incorporate a method to manage indoor air quality
  - Fresh air should be introduced and exchanged within the home
  - Passive and low cost methods available
    - Home Ventilating Institute [www.hvi.org](http://www.hvi.org)
  - Honeywell and Aprilaire have affordable models
    - Easily adapted onto existing HVAC equipment

# Closed-cell SPF Insulation for Walls – Combo Systems

**Closed-cell SPF can be combined with conventional insulations to completely fill the wall cavity**

- Can provide better thermal performance than conventional insulations – allows them to perform properly
- Adds air sealing and moisture resistance
- Often combined with batts and loose-fill insulations
- Combination Systems used in cold climates may still require a properly installed, interior vapor retarder





# SPF Insulation for Walls – Combo Systems R-values

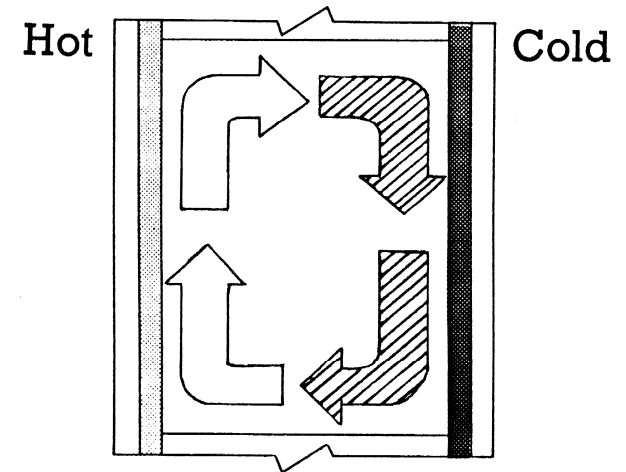


2x4 wood stud wall SPF Hybrid System Options		
Insulation layer thickness / Total R-value		
CC SPF (inch)	BIBS (inch)	BIBS / HP R value
½	3	16.2
1	2.5	17.4
1.5	2	18.6

2x6 wood stud wall SPF Hybrid System Options		
Insulation layer thickness / Total R-value		
CC SPF (inch)	BIBS (inch)	BIBS / HP R value
½	5	24
1	4.5	25.5
1.5	4	26.8
2	3.5	28
2.5	3	29.3

# Combination Systems - Why They Work

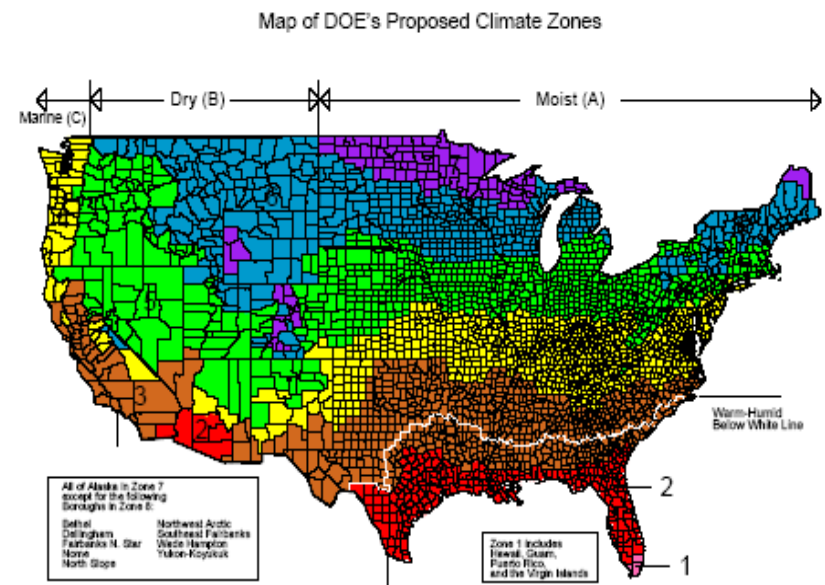
- Insulation 101 – How Traditional Insulation gets it's R-value
  - Effects from Wind washing, convection, etc. reduces effectiveness of most insulations
  - Maximizing the performance of other insulation
- Controlling air infiltration
  - Sealing the envelope with a single material as insulation and air barrier
  - It's Not Just R-value - Real World Performance vs. Labeled
- Controlling air movement is controlling moisture
- Using Spray Foam as air seal & the balance with conventional insulation offers a price point between all SPF versus no SPF



# Special Considerations for Vapor Drive in Combo Systems

## ■ Vapor Drive

- Must do analysis for proper vapor retarder placement
- How does vapor drive occur – what direction and where should the vapor retarder be
- SPF does typically NOT act as code defined vapor retarder in these assemblies!
- Code requirements for “warm-in-winter” vapor retarder placement is still enforced when combo systems are used
  - Continuous, properly installed vapor retarder
    - Flanged and face-stapled kraft is minimum
    - Poly or “smart” membranes recommended
- Or require enough R-value in SPF to eliminate vapor retarder and reduce potential for condensation



March 24, 2008



# Special Considerations – Wiring

- Standard 12 and 14 Gauge “NM” or “Romax” wiring
  - Limit the foam build up on the wires, let cool, then come back to build up needed thickness
  - Caution with extreme thicknesses over 14 gauge – lower melt temp on casing
- Electronics / Fiberoptic wiring – Low Voltage
  - Use extreme caution not to “bury” these types of wire in SPF
    - Softer casing that melts at much lower point
- Preferred methods
  - Use plastic sleeves to cover wires
  - Route through conduit
  - SPF crews get in before the low voltage is installed
- Issues with burying wire that needs to be accessed – breaker / main



# Applications – Pipes & Plumbing

## ■ Sprinkler Pipes – Typically made from cPVC

- Industry research conducted to disprove position of a major manufacturer, has made
  - No chemical breakdown occurs with installation of SPF material over CPVC
- Care should be taken to ensure SPF applications do not exceed the maximum pass thickness, and time is allowed to cool

## ■ Plumbing pipes, now using PEX (cross-linked polyethylene) more frequently

- Uponor (largest manufacturer of in-floor radiant heat tubing) has a position memo
  - No chemical breakdown of their material

## ■ **CAUTION:** Spraying PEX or CPVC that is full of air or fluid and capped or sealed off, can create pressure in the tubing and cause it to burst!

- Care must be taken to see if these lines are closed or open during spray and what they may contain. Many times, expansion valves or tanks are not plumbed in and the SPF will cause issues
- Again, care should be taken to ensure SPF applications do not exceed the maximum pass thickness, and time is allowed to cool



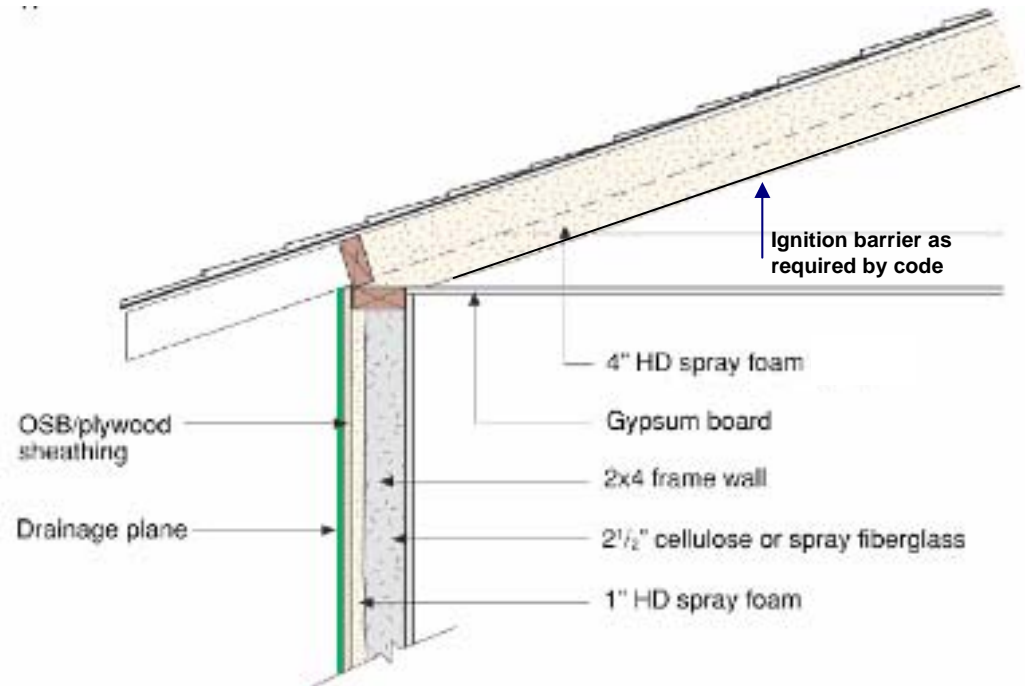
# Attic / Roof Insulation Options

- Unvented attic assemblies – Alternative approach
  - Full SPF or combination systems on the underside of the roof deck
- Insulation on the flat ceiling – Conventional application
  - Combination system of SPF for air seal & blown in for balance
- Soffit / Eave area installation
  - Maximize insulation over the top plate

# SPF Insulation for Unvented, Conditioned Attics

**Closed-cell SPF is the best insulation for unvented, semi-conditioned attics and cathedral ceilings**

- Improved energy savings when HVAC equipment is in the attic<sup>1</sup>
- May reduce damage from rainwater intrusion in attic<sup>2</sup>
- Wrap around trusses to get thermal break
- May improve structural resistance to high winds and hurricane loads



■ Moisture is controlled due to low vapor and low air permeance of the closed-cell spray foam

■ Spray foam is sprayed in direct contact with the roof deck

1. Unvented-cathedralized attics: Where we've been and where we're going, A. Rudd, J. Lstiburek and K. Ueno, Building Science Corporation.
2. Literature Review of the Impact and Need for Attic Ventilation in Florida Homes FSEC-CR-1496-05 31 May 2005
3. Attic and Crawlspace Ventilation: Implications for Homes in the Urban-Wildlife Interface, S.L. Quarles and A. TenWolde. Forest Products Society proceedings, 2005 ISBN 1892529.



# Benefits for High Wind / Storm Resistance

- Closed-cell spray polyurethane foam (ccSPF) insulation - One of the best solutions for strengthening the connection between the roof deck and the trusses in both new and existing homes.
- Sealing the venting with ccSPF to create an unvented attic has other benefits over improved fasteners and adhesives.
  - Prevents unwanted internal pressurization of the roof during high winds
  - Blocks wind-blown rain from entering the home
  - Acts as a backup waterproofing layer that minimizes water entering the home
  - Stops water absorption – only FEMA approved cavity insulation for use in homes built in flood zones



# Closed-cell SPF Insulation for Unvented, Conditioned Attics



# Open-cell SPF for Unvented, Conditioned Attics

**Open-cell SPF offers excellent insulation and air sealing in these areas**

- Improved energy savings when HVAC equipment is in the attic<sup>1</sup>
  - Creates a semi-conditioned space
- Reduce ignition by wildfires<sup>2</sup>
- Recommended to wrap around trusses
- Open-cell SPF is required to be protected by a thermal (storage) or ignition barrier (limited-access) depending on the use of the space



Ignition barrier as required by code

1. Unvented-cathedralized attics: Where we've been and where we're going, A. Rudd, J. Lstiburek and K. Ueno, Building Science Corporation.
2. 3. Attic and Crawlspace Ventilation: Implications for Homes in the Urban-Wildlife Interface, S.L. Quarles and A. TenWolde. Forest Products Society proceedings, 2005 ISBN 1892529.



# Special Considerations for Cathedral Ceilings and Unvented Attics

- Building Code - Now allowed by code in an unvented attic
  - 2006/9 IRC, Section R806.4 - Unvented conditioned attic space, with use of an “air-impermeable” insulation (spray foam)
    - In Zones Marine 4 or higher, SPF must perform as a vapor retarder or have one installed over open-cell
  - Combination Systems must use specified foam thickness per Zone
- Shingle Manufacturers’ Warranties
  - Certainteed – Approval letter
  - GAF/Elk won’t void immediately
  - Builders are consulted to check with all other manufacturers before proceeding with unvented roof assemblies
  - Option to install continuous vent chutes in each bay, then install SPF over vents to create a sealed attic over a vented roof deck
- Install code required ignition barrier or thermal barrier over SPF surface
- Combustion air for appliances – must be high efficiency or vented to the exterior

# SPF for Cathedral Ceilings

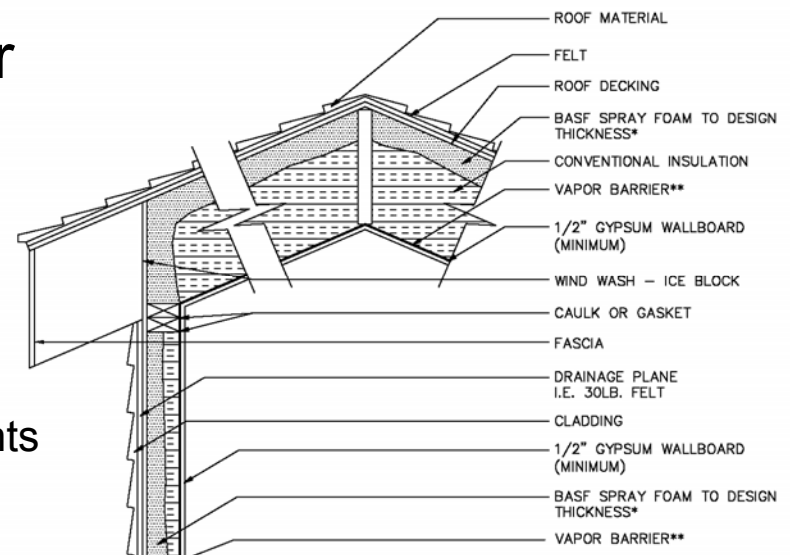
## **SPF is excellent for use in vaulted ceilings**

- Conforms to hard to insulate roof designs and fully seals areas
- Unvented approach can also be used here, applied directly to the underside of the roof deck
- Can be vented by installing SPF to rigid insulation or continuous chute vents to maintain air space



# Combo Insulation Assembly in Unvented Attics & Cathedral Ceilings

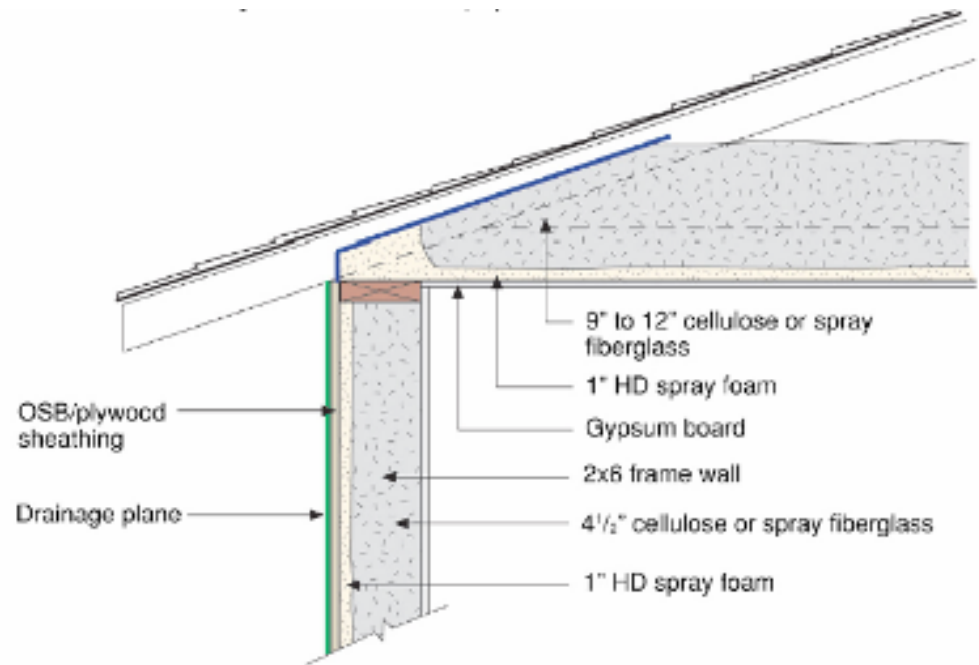
- Spray Polyurethane Foam installed between rafters
  - ccSPF is installed in direct contact against roof sheathing
  - In non-vented roof assemblies, use R-value dictated by 2009 Unvented Attics section of the IRC for air-impermeable (SPF) and air-permeable (fibrous) insulation assemblies
- Covered by other insulation materials
  - Fiber glass batts – kraft or unfaced (depending on climate and vapor conditions)
  - Blown-in-blanket (BIBS) fiber glass systems
  - Net and blown or wet-spray cellulose systems
  - Open cell foam systems
- Thermal barrier or ignition barrier fire protection
  - Code listed products: 1/4" wood structural panels or hardboard, or 3/8" particleboard, gypsum board or 1.5" mineral fiber insul. (unfaced glass fiber batt or blown FG is usually accepted)  
– Interpretation from ICC
  - Testing to support use of ignition barrier paints with various products



# SPF Insulation for Attic Floors

## - Combo Systems

- SPF can be used below other insulations to air seal and strengthen attic floors\*
- Covered with blown fiber glass or cellulose – To be determined by local building official what qualifies as ignition barrier per code requirement
- It is ideally suited to seal crevices around recessed lighting\*\*, vent pipes and wiring in the attic



\*Use caution when spraying onto sheetrock – 1/2"-1" initial passes


\*\*Maintain 3" separation from all lights and fireplaces flues, per building code



# SPF Insulation for Attic Floors

## - Combo Systems





# Special Considerations - Flat Ceilings

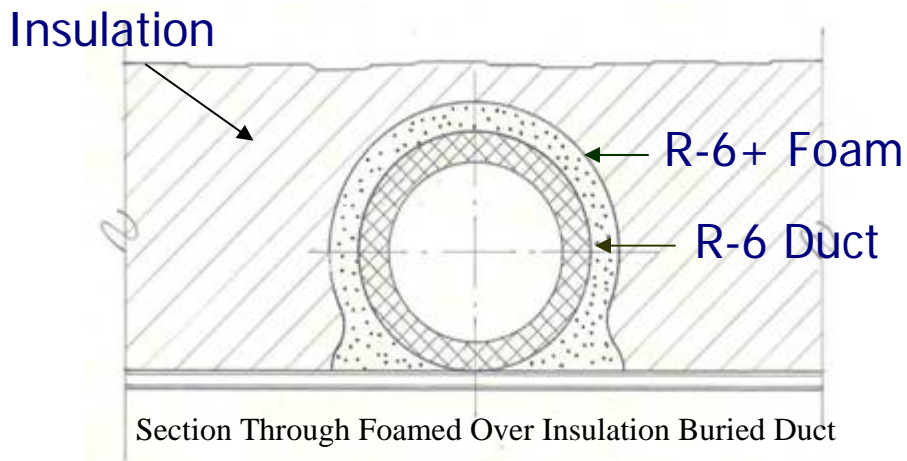
## ■ Spraying onto Sheetrock

- Extreme caution!!!!
- Sheetrock can warp
  - When sprayed too thick in a single pass or too quickly (when building up passes)
    - Use thinner flash coat, let cool, then come back with thicker passes
- Recessed lights must be boxed and properly sprayed over for air seal
- Foam must be covered with 1.5" mineral fiber, or other rigid sheet product, per ignition requirement in building code



# Closed-cell SPF Insulation for Ductwork – Retrofits

- Steven Winter & Associates (SWA) study
  - Substantial performance improvements using ccSPF (only!)
    - Increases insulation
    - Controls condensation
    - Controls duct air leakage



Computer Modeling of Heat Flow From Insulation Buried Duct

# SPF Insulation for the Soffit/Eave Area - Combination systems in Flat Ceilings

**SPF is a great upgrade and solution for insulating the eave area**

- Applied near the eave/soffit area, the high R-value of SPF can provide the insulation needed to prevent ice damming in cold climates and wind-washing of the blown insulation

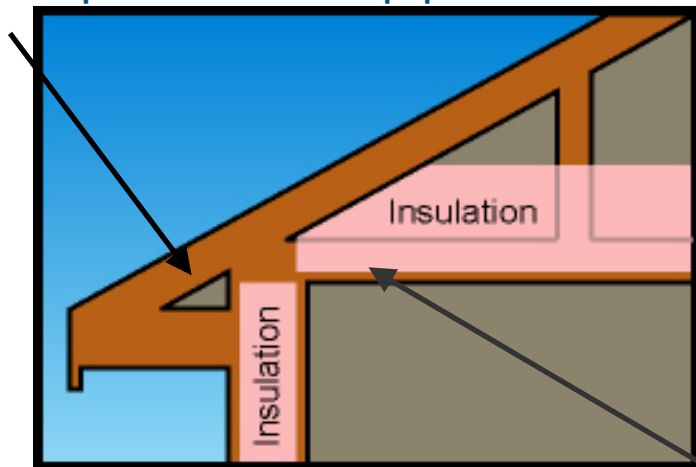


“In severe cold and cold climates the critical air seal also applies to attic construction and ice dam prevention and repair. Again, high-density spray foam [is the best] application to the exclusion of all other materials and approaches”

*Rigid Spray Foam Insulation: Residential and Low-Rise Commercial Construction – Joe Lstiburek, Building Science Corporation report, March 2006*

# Performance Improvement with SPF – Standard Roof Truss

Possibility of ice dam formations because not all insulation value can be placed over top plate



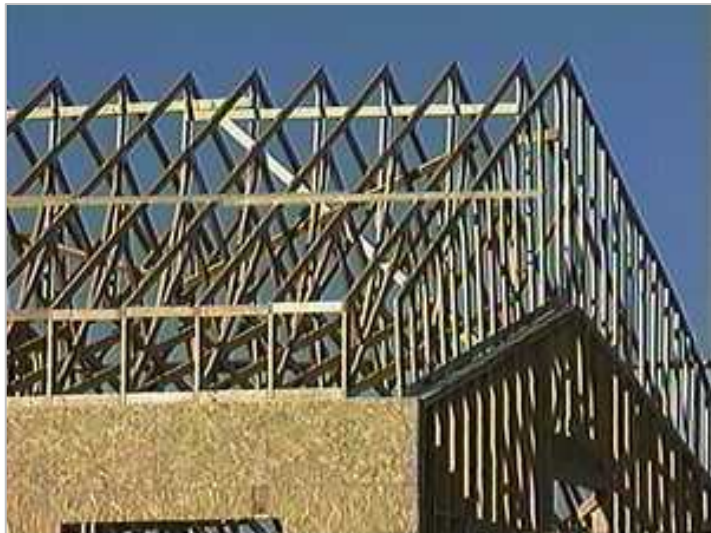
- Ceiling insulation code requirements assume standard truss systems

Cold corners contribute to condensation and mold growth

# Alternative Approach – SPF OR Raised Heel Truss

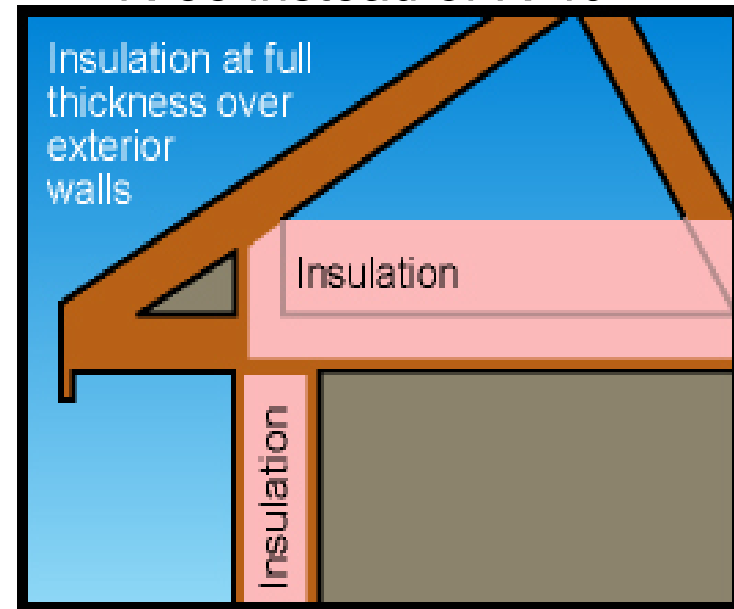


ccSPF to  
full R-value



- Raised Heel/Energy Truss credit if insulation is full height (or full R-value) over exterior wall (*Prescriptive*)

- ☐ R-30 instead of R-38
- ☐ R-38 instead of R-49





# SPF Insulation for Under Houses / Garage Ceilings

**SPF can be applied to the underside of the bonus rooms above garages**

- Prevent or fix call back issues related to “cold floor” complaints
- Completely seals against air infiltration – reduces potential for freezing pipes and other moisture concerns
- Covered with sheetrock – no exposed SPF in garages



“In the retrofit area, Medium-density spray foam can do things no other insulation system can do with respect to both air-tightness and vapor control. ... In such applications the Medium-density spray foam is not water sensitive, it provides both a thermal barrier and air barrier without creating a vapor barrier. A vapor retarder is provided to allow drying of the assembly in both directions.”

*Rigid Spray Foam Insulation: Residential and Low-Rise Commercial Construction*  
– Joe Lstiburek, Building Science Corporation report, March 2006

# Cantilever Insulation Combo



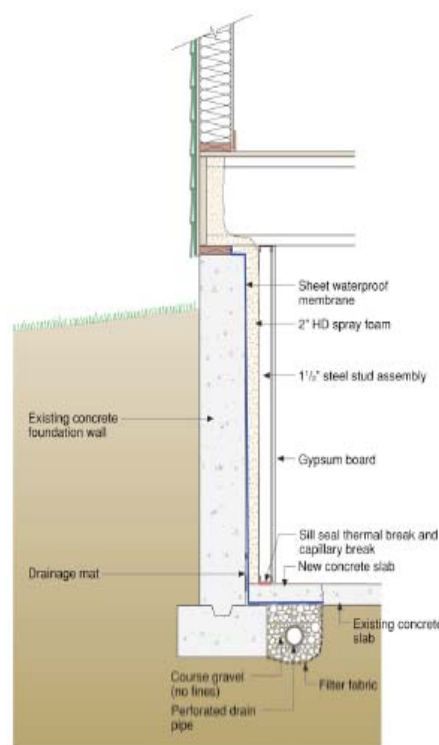
## Application Guidelines:

- Use caution with thick foam applications in hard to reach areas – self-ignition concerns

# SPF Insulation for Rim Joists

## **SPF seals and insulates rim (band) joists, overhangs and behind stairs**

- Easily applied in hard-to-reach places
- Does not compress or sag like fiber glass batt insulation...Remains in place
- Eliminates air infiltration and controls moisture at rim joist, mud-sill and masonry
- No fire protection necessary per Plastics code section (following guidelines)
- Caution on pressure treated lumber – picture frame to ensure proper adhesion



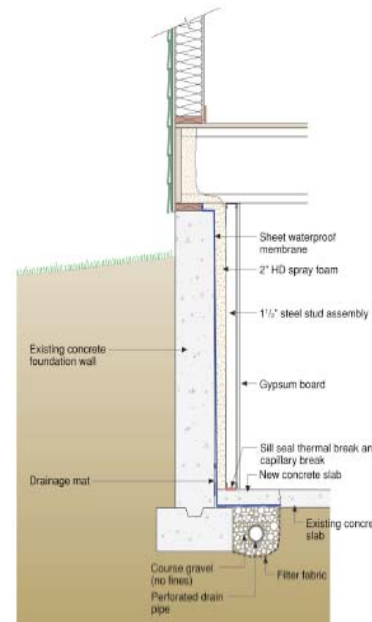
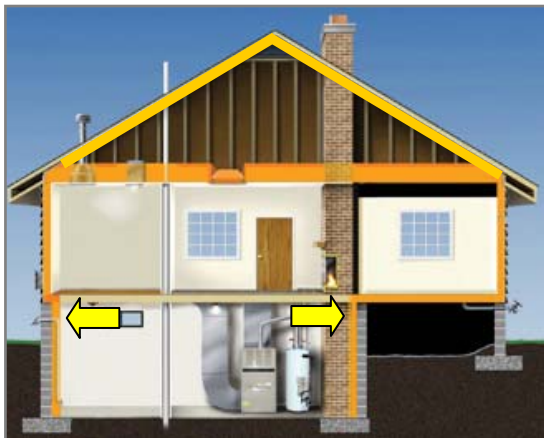
In 2009 IRC, open cell foam is allowed in this area with no fire protection necessary per Plastics code section, if meets limitations (3.25" max and Class 1)



# Closed-cell SPF Insulation for Basements

**The ccSPF water-resistance and vapor retarder properties ideal for internally-insulated below-grade walls**

- Best if used continuously between masonry walls and framing.
- Great for renovation/retrofit
- IECC specifies R5 of continuous SPF to be equivalent to R13 of cavity insulation
- Must be covered by Sheetrock or 15 min. thermal barrier



“Interior basement application of medium-density spray foam in both new and retrofit applications has significant advantages over most conventional interior insulation basement approaches. ... Interior approaches using medium-density spray foam have no cost conventional alternative technology – particularly in regions prone to flooding.”

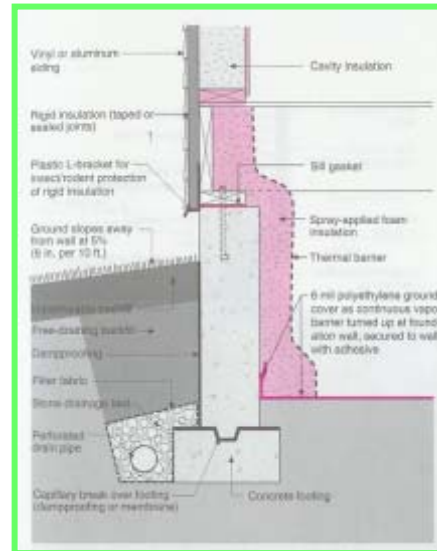
*Rigid Spray Foam Insulation: Residential and Low-Rise Commercial Construction – Joe Lstiburek, Building Science Corporation report, March 2006*



# Closed-cell SPF Insulation for Crawlspaces

**ccSPF is an ideal answer for problem crawlspaces (do not use open-cell)**

- Can be applied between joists
- Easily fits around obstructions and permanently remains in place
- Due to its water resistance, it offers the best insulation alternative for un-vented crawl spaces
- Retrofit opportunity
- Must be covered with ignition barrier – fiber / mineral glass or rigid board



Detail of an un-vented crawlspace application of SPF

Figure 7.35 from Builder's Guide to Cold Climates by J. Lstiburek





# Applications to Avoid with Open-cell SPF

- Applications NOT suitable for installation of open-cell insulation
  - Ductwork
    - Vapor permeable – condensation can occur
  - Below grade / below slab
    - Basement walls, crawlspace walls and under slab are high moisture potential areas
    - No soil contact – open-cell foam can and will wick water

# Spray Polyurethane Foam Insulation Application Areas

CAVITY INSULATIONS	Performance					Applications						
	R-value	Air Barrier	Vapor Retarder	Waterproof	Structural	Walls	Ceilings (flat)	Sealed Attics	Cathedral Ceil.	Basements	Rim Joists	Retrofit
Cellulose Wet-Spray	3.7					*			*			
Cellulose Loosefill	3.5 to 3.8					*	***		*			
Fiberglass Batts	3.2 to 4.3		y			**	*		*	*	*	
Fiberglass Loosefill	4.2 to 4.4					*	***		*			**
Open-Cell SPF	3.4 to 3.8	Y				**	*	**	**		**	
Closed-Cell SPF	5.9 to 7.1	Y	Y	Y	Y	***	*	***	***	***	***	**

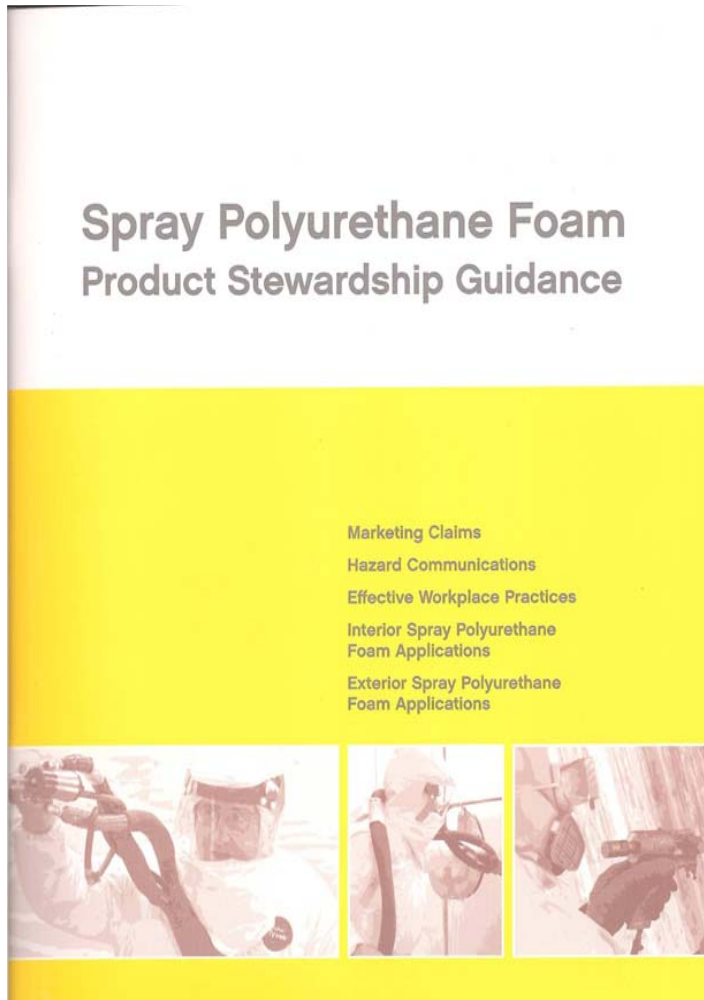
**Know the best place to use each type of spray polyurethane foam!**



# Questions on Applications?

- 10 Minute Break

# Safety with Spray Polyurethane Foam (SPF)



- New Government Oversight Committees
- Support from American Chemistry Council's Center for the Polyurethanes Industry (CPI)
- Full details for safe handling of Spray Foam, including Respiratory Protection and other Personal Protection Equipment (PPE) found at:

[www.spraypolyurethane.org](http://www.spraypolyurethane.org)



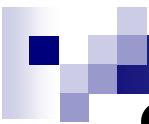
# Safety with SPF Applications

- New standards from EPA, OSHA, NIOSH.....
  - BASF was a leader on the joint committees and will continue to support efforts
- OSHA much more active on SPF jobs – Areas of concern:
  - Keep two copies of MSDS on truck at all times, in cab and box
    - Not just for foam but all chemicals
  - Employees must know how to read and tell inspector about MSDS, fall protection, mask maintenance, eye wash stations, fit testing & respirator training, etc.
  - Written Hazard Communication Program
  - Medical Surveillance Program
    - Yearly testing
  - Model Respirator Program
    - Respirator Fit Testing



# Application Safety – MDI Protection

- Why is it important to protect yourself from the MDI component (A / Iso) when spraying and handling SPF insulation?
  - Contact with excessive amounts can be harmful to your health
  - Overexposure due to material that is sprayed and/or heated comes from the following:
    - Breathing airborne concentrations
    - Getting MDI on your skin
    - Getting MDI in your eyes
  - Continued overexposure lead to sensitization
    - Once sensitized, very limited exposure will create health effects



# Safety with SPF Applications

- Personal Protection Equipment (PPE)
  - Mechanical ventilation or engineering controls is the first line of protection
    - If this can not be done or in order to provide a greater magnitude of worker protection, PPE is the next step.
  - Respiratory Protection
    - Interior Applications
      - Full Face Mask
      - Applicator – Supplied Air Respirator (SAR)
      - Helper for application – SAR Iso
      - **With approval by your respiratory program administrator** - beyond 30 feet of application area air purifying respirator (APR) can be utilize (subject to change)
    - Exterior Applications
      - Outside application – Air Purifying Respirator approved for use



# Safety with SPF Applications

## ■ Personal Protection Equipment (PPE)

### □ Body Protection

- Chemical Resistant Suit (HOT!!!)
- Chemical Resistant Boots/Booties
- Nitrile Gloves to protect hands from absorbing chemicals
- Rubber Gloves at all time
- Head masks

### □ Eyewear with side shields

- To protect from chemical splashes and absorption of mists into eyes

### □ NO SKIN SHOWING

### □ Owners must supply necessary PPE for workers

## INTERIOR SPRAY POLYURETHANE FOAM (SPF) INSULATION PERSONAL PROTECTIVE EQUIPMENT



OSHA REQUIRES PROTECTION FOR SPRAY POLYURETHANE FOAM APPLICATORS - THOSE USING HIGH PRESSURE DISPENSING EQUIPMENT - AS FOLLOWS:

- **HARD HAT:** Use if needed to protect head from falling objects.
  - **EYE PROTECTION:** Must be worn when spraying or working in areas where spray polyurethane foam aerosol or mist is present. Eye protection can be incorporated in a full face mask design.
  - **SKIN PROTECTION:** Personal protective garments are used to keep spray and mist from contacting skin and clothing. Personal protective garments are not just for convenience - in rare circumstances, skin exposure to spray or mist may result in serious health concerns.
  - **Nitrile gloves** are used to protect the hands; fabric gloves fully coated in nitrile, neoprene, butyl, PVC or cotton gloves can be used over nitrile gloves for spraying. - Tape may be used to seal arm and feet openings as needed.
  - If a breach of gloves or garments is noticed, change out the personal protective garments immediately or repair with tape over tears or rips.
  - **RESPIRATORY PROTECTION:** Interior applications by definition are conducted indoors and may not have significant natural air movement or are conducted in smaller cubic air volume spaces. For interior applications, sprayers must wear a NIOSH-approved Supplied Air Respirator or SAR. Helpers also may need a SAR, if working in close proximity to the sprayer. A full facepiece Air Purifying Respirator or APR with organic vapor/particulate (P100) cartridges may be used by helpers if adequate ventilation is provided or if outside the immediate overspray area.
  - **MAINTENANCE:** Employees should care for and maintain respirators as instructed by the manufacturer and store in a clean, dry, sanitary location (such as in a sealed bag or container - especially for organic vapor cartridges), and away from direct sunlight.
- Inform job superintendents if:
- respirators no longer fit or are damaged;
  - hazards are not adequately controlled in the workplace; and
  - concerns exist regarding the Respiratory Protection Program.
- **WORK BOOTS:** Steel-toed work boots are desirable in most work areas. Protection from overspray can be provided by rubber overshoes or disposable coveralls, if it does not compromise the grip of the work boot.
  - Always read and understand the spray polyurethane foam manufacturer's Material Safety Data Sheet or MSDS before starting any spray foam application.

ACTIVITY	Respiratory Protection	Hand Protection	Eye Protection	Skincare Protection	Foot Protection
Safety Glasses with Side Shields or Safety Goggles		✓		✓	✓
Supplied Air Respirator (SAR) Filled Full Face Mask or Hood			✓		
Air Purifying Respirator (APR) Organic Vapor (P100) Cartridge + Dust Protection	✓	✓		✓	✓
Nitrile Gloves	✓	✓	✓	✓	✓
Disposable Coverall	✓	✓	✓	✓	✓

This document was prepared by the American Chemistry Council (ACC) Center for the Polyurethanes Industry (CPI) and the Spray Polyurethane Foam Alliance (SPFA). It is intended to provide general information to persons who may handle or apply spray polyurethane foam chemicals. It is not intended to serve as a substitute for in-depth training or specific handling or application instructions, nor is it designed or intended to define or create legal rights or obligations. It is not intended to be a "best" manual, nor is it a prescriptive guide. All persons involved in handling and applying spray polyurethane foam chemicals have an independent obligation to ascertain that their actions are in compliance with current national, state and local laws and regulations and should consult with their employer concerning their duties. Any mention of specific products in this document is for illustrative purposes only and is not intended as a recommendation or endorsement of such products.

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FOR MORE INFORMATION, VISIT:  
The American Chemistry Council's Center for the Polyurethanes Industry  
[www.americanchemistry.com/polyurethane](http://www.americanchemistry.com/polyurethane) or [www.spraypolyurethane.com](http://www.spraypolyurethane.com)  
Spray Polyurethane Foam Alliance  
[www.sprayfoam.org](http://www.sprayfoam.org)






# Safety with SPF Applications

## New OSHA and EPA Rules and Guidelines

- No other trades in the building
- Recommended 24 hour before any trades reenters area while using sufficient ventilation to air out area sprayed
- Mandatory 24 hours before reentry for retrofits (Homes) and you must use sufficient ventilation to air out area sprayed
  - Try to isolate to one area as much as possible
- Post Warning Signs
  - All Entry points must be posted with
    - Breathing Hazard (while applying and 2 hrs after)
    - Safe to reenter time
  - No Hot Work



# Applications – Health & Safety

## Warning Sign


**WARNING**

**Breathing Hazard During  
The Application of Insulation  
Materials**

**DO NOT ENTER**

**Without Proper Breathing Protection**

**NO SMOKING**



## Applications – Fire Safety

**\*\*CAUTION\*\***

**NO HOT WORK!**

No open flames, torches or other hot surfaces should come in contact with Spray Foam surface. Protect with fire resistant material!

# Safety – Reading Requirements

- *Read and understand the product Technical Data Sheet and Material Safety Data Sheets*
- *Read and understand Industry application guidelines, and applicable OSHA / other government requirements*
- It is necessary to train and document this with all the SPF workers. They must be able to tell OSHA inspectors about MSDS, fall


**HAVE YOU READ THE MSDS?**  
BEFORE USING ANY SPRAY POLYURETHANE INSULATION PRODUCT, YOU MUST...

**READ AND UNDERSTAND THE ENTIRE MATERIAL SAFETY DATA SHEET (MSDS)**

<b>Sections 1, 2, 3*</b> <b>CHEMICAL IDENTIFICATION HAZARD WARNINGS COMPOSITION</b>	Do you know the <b>hazards</b> of every chemical you are handling: <ul style="list-style-type: none"><li>• Component A (Isocyanate);</li><li>• Component B (Resin, Polyol, Amine Catalyst, Blowing Agent, Fire Retardant);</li><li>• Solvents;</li><li>• Cleaning Solutions;</li><li>• Coatings?</li></ul>
<b>Section 8*</b> <b>PERSONAL PROTECTION</b>	Are you using the correct <b>Personal Protection Equipment</b> for the job: <ul style="list-style-type: none"><li>• Supplied-Air Respirator,</li><li>• Eye Protection,</li><li>• Gloves,</li><li>• Coveralls,</li><li>• Boots?</li></ul>
<b>Sections 6 &amp; 7*</b> <b>ACCIDENTAL RELEASES STORAGE AND HANDLING</b>	Are you <b>storing and handling</b> the chemicals as directed? <ul style="list-style-type: none"><li>• Do you know how to properly contain and clean a <b>spill</b>?</li></ul>
<b>Section 4*</b> <b>FIRST-AID</b>	What should you do if there is an <b>accidental exposure</b> ? <ul style="list-style-type: none"><li>• Do you know <b>first-aid</b> procedures?</li><li>• Do you have first aid materials at the work site?</li></ul>
<b>Sections 5, 9-16*</b> <b>OTHER INFORMATION "READ THE ENTIRE MSDS"</b>	Did you know that other information is provided on an MSDS? <ul style="list-style-type: none"><li>• Fire-Fighting Measures;</li><li>• Physical-Chemical Properties;</li><li>• Stability and Reactivity;</li><li>• Toxicology;</li><li>• Disposal;</li><li>• Transportation; and</li><li>• Regulatory information?</li></ul>

For more information, visit:  
The American Chemistry Council's Center for the Polyurethanes Industry  
[www.americanchemistry.com/polyurethanes](http://www.americanchemistry.com/polyurethanes) or [www.spraypolyurethane.com](http://www.spraypolyurethane.com)  
Spray Polyurethane Foam Alliance  
[www.sprayfoam.org](http://www.sprayfoam.org)

\* According to ANSI Z39-2304-10 section MSDS, OSHA does not mandate specific sections, your MSDS may be different, but all information should be available. Published August, 2005. This document may be updated. For the most current version of this document, see [www.americanchemistry.com/polyurethanes](http://www.americanchemistry.com/polyurethanes), [www.spraypolyurethane.com](http://www.spraypolyurethane.com), or [www.sprayfoam.org](http://www.sprayfoam.org). This work is protected by copyright. Users are granted a nonexclusive royalty-free license to reproduce and distribute this document, in whole or in part, provided that the work must be reproduced in its entirety, without alterations, and (2) copies of the work may not be sold.

 American Chemistry Council  
Center for the Polyurethanes Industry

 SPRAY POLYURETHANE FOAM ALLIANCE  
**SPFA**



# Application Safety Considerations

## ■ Other Equipment & Considerations

- ☐ Safety Arrest (if applicable) Lines, Tapes, Spotter, Rails Systems and/or combination
- ☐ Ladder safety, fall protection, other equipment that is OSHA required and compliant
- ☐ Fire Extinguisher Near spray unit and spray area
- ☐ First Aid Kit Eye wash and minor injuries can be addressed
- ☐ Spill Containment Absorbent material or pads
  - Keep **Spill Kits Accessible**
  - Be sure to reference **CORRECT MSDS** immediately
  - Decontaminate and dispose of material per MSDS
- ☐ Consider **overspray concerns** in open areas with high winds



# Homeowner benefits

- Comfort
- Affordability
- Energy efficiency
- Healthy indoor environment
- Durability
- Environmental responsibility



# Homeowner Benefits: Comfortable

## ■ Comfort

- ☐ No air leakage = no drafts!
- ☐ Consistent temperatures
- ☐ Consistent humidity levels
  - Control condensation on surfaces
- ☐ Improved sound control
  - Control airborne noise movement through wall





# Homeowner Benefits: Efficient and Affordable

## ■ Energy efficiency

- ☐ No air leakage = savings up to 40%!
- ☐ Conditioned air stays inside the home
- ☐ Superior insulation R-value

## ■ Affordability

- ☐ No air leakage = lower maintenance!
- ☐ Lower energy bills
- ☐ HVAC may be downsized or “right-sized”
- ☐ Low lifecycle cost



# Homeowner Benefits: Healthy

- Healthy indoor environment
  - No air leakage = less chance of mold!
  - Pollutants, allergens stay outside
  - VOC- and urea formaldehyde-free
  - No off-gassing




# Homeowner Benefits: Durable

## ■ Durability

- ☐ No air leakage = less moisture intrusion
- ☐ Helps prevent moisture damage from condensation
- ☐ FEMA approved for flood regions
- ☐ Increased structural strength, rack and shear





# Homeowner Benefits: Environmental Protection

- Environmental responsibility
  - No air leakage = less waste!
  - Reduced fossil fuel consumption
    - Lower “carbon footprint”
  - Reduced greenhouse gas emissions
  - Ozone protection – Non-ozone depleting blowing agents
  - Reduced construction waste
  - Supports advanced framing techniques
  - Eco-Efficiency Analysis

# Builder / architect benefits

- Differentiation
- Fast application
- Fewer call-backs
- Training and technical support
- Sales and marketing support
- Applicator Network



# Builder Benefits: Differentiation

## ■ Differentiation

- High-performance homes
- LEED®, NAHB Green Building Program, Environments for Living and ENERGY STAR® (and many others!)
- Offer a “energy-efficiency” package or “green” upgrade
- Design freedom
  - Spray foam conforms to any shape
  - Structural strength allows for atria, turrets, etc.
  - Optimized framing



# Builder Benefits: HVAC

## ■ Right-sizing of HVAC System

- Tightening the house envelope enables the use of smaller less costly HVAC equipment.
- Unvented, conditioned space for air handling units and ductwork provides more efficient operation
  - Controls duct leakage to exterior, capturing energy costs
- An unvented attic also provides more useable storage space and minimizes wind-driven rain damage.



# Builder Benefits: Callbacks

## ■ Fewer call-backs

- Reduced air leakage = Fewer comfort complaints!
  - Inconsistent room temperatures, drafts and airborne moisture controlled through the building envelope.
- Lower chance of ice damming
- Robust construction, added structural strength
- Reduced sound transmission
- Controlled moisture movement

## ■ “Based on a survey of nearly 32,000 homes built in 2005, average callback costs are \$5398”

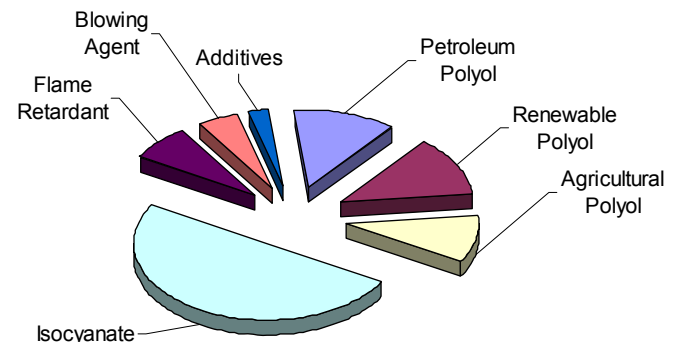
- Steve Easley – 2006 EEBA presentation





# SPF Chemistry and “Green” Content

- SPF is created by the reaction of two liquids – ALL chemistry is nearly the same:
  - Component A- Isocyanate: MDI-PMDI (Adhesive/Hardener)
  - Component B- Polyol resin: Polyols, catalysts, blowing agents, flame retardants, & surfactants
- “Green” or sustainable components can make up a portion of only the polyols in the B drum – all other components remain fairly equal amongst spray foams
  - Post-scrap plastics reprocessed (recycled soda & water bottles)
  - Renewable or plant-grown materials ([sugar beets](#), soy, cane products)
- Based upon the total percentage of all polyols that have the capacity of being recycled or renewable in content, spray foams contain no more than 15-20% of these materials total





# Sustainability Benefits of Spray Polyurethane Foam

- **Minimizes Energy Usage**
  - Superior R-value for Maximum Energy Efficiency (ccSPF)
  - Reduced uncontrolled air leakage
- **Helps reduce fossil fuel usage, due to energy savings**
  - Helps consumers lower carbon footprint
- **Increased Thermal Comfort**
  - No drafts, consistent temperatures
- **Ozone Protection**
  - Non-ozone depleting blowing agents (ccSPF)
- **Low-emitting materials**
  - Meets or exceeds VOC requirements for LEED – low / zero values
  - SPFs contain no urea formaldehydes
    - Many products Greenguard® listed, ULe approved or ICC SAVE verified



# Sustainability Benefits of Spray Polyurethane Foam

## ■ Recycled Content

- Most SPF contains 5-10% post-industrial and/or post-consumer recycled content

## ■ Agricultural-based content

- Typically sucrose-based or soy-based polyols, up to 10-15% by total volume

## ■ Applications create minimal debris and waste (ccSPF)

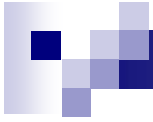
## ■ Advanced framing techniques – 24 inch o.c. vs. 16 inch o.c. or 2x4 vs. 2x6 (ccSPF)

- Less lumber usage

## ■ Life Cycle Assessment – Long term performance

### □ Eco-efficiency analysis

- Computer modeling shows SPF has lowest life-cycle cost/impact on environment than other insulations
- Available as a stand alone AIA CES Course from BASF



# Questions?

- Thank you for your time and attention today!

# THANK YOU!



BASF Corporation is committed  
to sustainable solutions for construction applications.

[www.spf.basf.com](http://www.spf.basf.com)

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